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Title: The Ring Current - Dynamics, Sources and Mechanisms

Abstract:
We present our latest findings about the mechanisms for ring current intensification and its dynamics during geomagnetic storms. We use data from the IMAGE/HENA instrument and the RAPID and CODIF ion spectrometers on board the Cluster satellites. Various supporting data-model comparisons allow us to draw conclusions about the source and energization mechanisms of the storm-time ring current. We summarize by reviewing the role of the ring current in radiation belt dynamics, and in magnetosphere-ionosphere-thermosphere coupling.

A geomagnetic storm is historically referred to as the intensification
of the ring current. The cause of the intensification is enhanced magnetospheric convection and substorms. Convection is enhanced through dayside reconnection during southward IMF, which transport plasma from the lobes, to the plasmasheet and into the ring current region where it is energized by betatron acceleration. Substorms energize plasma further through the rapid dipolarization reconfiguration of the magnetic field due to a disruption of the tail current. Substorms energize in particular O+ ions that flow out from the polar ionospheres during enhanced solar wind dynamics pressure and/or southward IMF. During the course of the storm ionospheric O+ ions are transported to the plasma sheet mainly through centrifugal acceleration where they achieve an energy of a keV or so. At the substorm dipolarization the O+ ions are energized non-adiabatically and can reach several 100's keV, whereas the protons behave more adiabatically and experience a much more gradual energization.

The HENA instrument on board IMAGE images the hydrogen and oxygen ring
current in the ~10-200 keV (H) and ~50-300 keV (O) range. HENA has provided global images of the ring current since May 2000 until Dec 2005. A constrained linear inversion technique is used to extract the ion distribution in the ring current, which is validated by in-situ satellite observations.

Cluster carries the RAPID instrument which provides mass resolved energy spectra in the 20-400 keV for electrons, 40-1500 keV (4000 keV)
for hydrogen, and 10 keV/nuc - 1500 keV (4000 keV) for heavier ions. The CIS/CODIF instrument on board Cluster resolves H+, He+ and

O+ ions in the 15 eV – 39 keV range.